April 29, 2004

To whom it may concern:

I am opposed to BPL technology as a broadband solution. I fear that its deployment will adversely affect licensed services. I have read intelligent comments, such as those by Stephen H. Dove in Docket number 03-104 and by John Matz, who in detail shows how methods used to assure Part 15 compliance for unintentional radiators are insufficient for BPL. I have also seen the ARRL video where the man drives around with a mobile amateur station and is blanketed in noise from a BPL rollout. I am convinced that BPL will not integrate well with licensed services, especially those on HF bands, as it will cause interference, even if Part 15 compliance is claimed.

I include comments from John Matz, which I found insightful. I am not the author of these comments, and I include them without his permission. They are publically accessible via his website:
http://my.core.com/~jematz/bpl-1.html
http://my.core.com/~jematz/bpl-2.html

Please consider the evidence and comments already submitted by private citizens and the ARRL. Please act in the interest of licensed services by preventing the acceptance and deployment of BPL as a broadband solution.

Sincerely,
Matt Lehman, KD5TAN

[attachment]

Comments on BPL or PLC.
24 February 2004

* INTRODUCTION *

My name is John Matz. I have been an amateur radio operator for 40 years, currently Amateur Extra Class, current callsign KB9II. I have a BSEE and MSEE from Northwestern University. I am a Professional Engineer. I worked as an antenna designer for 4 years, for Motorola Research for 4 years, in Motorola Microwave for 9 years, in Motorola Cellular Infrastucture for 10 years. I am now an independent consultant.

* BPL COMMENTS *

Part 15 limits:

If it's an unintentional radiator, are there any limits below 30 MHz at all? Does it have to meet the intentional radiator limits?

If it's an intentional radiator, 30 uV/m at 30 meters below 30 MHz. But in what bandwidth? Above 1000 MHz the resolution bandwidth is given as 1 MHz minimum. But I saw nothing below 1000 MHz.

*** You must specify a bandwidth !!!***

Below 30 MHz, Part 15's limit is 30 uV/m @ 30 meters. This corresponds to about -80 dBm/sq meter at 30 meters. At 14 MHz and lower, atmospherics are conservatively estimated at 34 dB above the thermal noise floor. The 30m and 20m bands can be much quieter. The atmospheric noise using a dipole receive antenna in a 10 kHz BW shortwave receiver is about -100 dBm equivalent at the antenna (NEP). That's about 2 uV on 50 ohms. Using Part 15 limits measured in a 1 MHz BW, the interference is about -65 dBm in 1 MHz, or about -85 dBm in 10 kHz, or about 15 dB above typical atmospherics. If the Part 15 limit is measured in 10 KHz BW, noise could be 35 dB above atmospherics. Part 15's 30 uV/m, if measured in 1 KHz BW, would give interference at 45 dB over atmospherics.

*** You must specify a bandwidth !!!***

At 30 MHz, the atmospherics will drop down to maybe 4 dB above thermal noise, so any BPL noise at Part 15 limits becomes really obvious at 40 dB to 70 dB over receiver noise.

Just a comment, light dimmers, brushes, etc. will cause 60/120 Hz modulation of the noise. This will be very annoying on AM detection for SW BC, etc.

I think people have forgotten that 30 dB is a factor of 1000 and 60 dB is a factor of 1,000,000. That's big !!

* MORE BPL COMMENTS *

The BPL NPRM Appendix C:

The test procedure calls out a loop antenna below 30 MHz, oriented in a vertical plane and rotated about a vertical axis. If I read this right, this does NOT measure any horizontally polarized radiation.

Above 30 MHz, a biconical dipole, parallel to the wire, rotated V and H, is specified. If I read this right, it does not measure any Er. This Er doesn't propagate, but it's still noise to be picked up locally.

* ADAPTIVE INTERFERENCE COMPENSATION *

one of the proposed interference mitigators is adaptive compensation. I am not sure what this will be, but in OFDM as proposed, it may simply mean not using data carriers on a frequency where the unit can detect activity. In a DSSS system, notches may be used to remove offending frequencies. The adequacy of these countermeasures is questionable if many frequencies are in use in the system and/or a transmission has not occurred near the frequency in question (SWL's). Notches of 30 dB help but don't eliminate a 60 dB degradation.

* GENERAL*

Part 15, as it stands today, is very inadequate to control noise and interference. The measurement bandwidth is not specified. The standards are the same at 1.705 MHz and at 30 MHz. That's a factor of 17 in frequency, a factor of 300 smaller in dipole antenna capture area (25 dB), and most importantly, a reduction in atmospheric band noise of 50 dB from a simple vertical or dipole. Also antennas at 30 MHz are often 10 dB gain, that is, they have 10 times the capture area of a dipole. That means that 30 uV/m in 1 MHz varies from -55 dBm in 10 kHz with an atmospheric noise of -80 dBm (25 dB degradation) to -70 dBm from a small beam pointed at the power wires with an atmospheric noise level of -130 dBm (60 dB degradation).

The only reason Part 15 sort of works is that spurious emissions used to be unmodulated and narrowband carriers. That's why bandwidth was not even specified. A problem would only even exist for a small extent in frequency. In the case of BPL, heavy data modulation fills the whole spectrum with interferers. It will be bad over whole bands at a time.

People have asked will it have long distance effects since these bands support ionospheric propogation. Well at 10 MHz, free space path loss in 300 kilometers is about 80 dB more than the loss in the first 30 meters, so the contribution of a short section of power line should be very small. Having 1000 of the noisy sections would raise the noise 30 dB, still OK.

* MODULATION *

Apparently the modulation techniques are proprietary, so we must assume something. If the data rate per user is 1 MBPS and we could have ten downloads simultaneously, the aggregate data rate is 10 MBPS. Since the system is relatively robust, we will assume a simple modulation scheme, so the modem output occupies 10 MHz of spectrum in the range 2 to 80 MHz. Let's also assume that two systems are in service so 20 MHz is used, with guard bands, this is 30 MHz. This is about half the available band. It is possible to "move around" a bit, especially with an OFDM-based modem, but since almost all the spectrum is allocated, the modem is going to step on someone. Of course, propagation being variable, there may be preferred frequencies to avoid at certain times of day and season and solar cycle. If the system is lightly loaded so there is some "elbow room", it might be acceptable.

* RECOMMENDATIONS *

If the BPL network just makes Part 15, the interference potential is huge.

The keys to operating this system without interference is frequency agility of the transmitters/injectors and the willingness of the FCC to call this a Part 15 service that must not interfere with licensed stations and operations. They must adjust or shut down. The problem is that what will be considered more important, one interference problem or 500 paying Internet connections dropped. In the past, the FCC seemed to do what had to be done. Now ... I don't know. The FCC may just buckle under public pressure.

Anyway, Part 15 needs to be re-vamped, tightened, and clarified to be really usable to control interference in the 21st century. The measurement bandwidth should be specified. Similarly, the spurious specification for transmitters of -13 dBm should have a measurement bandwidth associated with it. Also, -13 dBm is really not tight enough at VHF and UHF frequencies to control interference. Japanese and European goals are often 20 dB tighter to be accepted by regulatory agencies.

Also the measurement techniques of NPRM Appendix C need to be revised. Not all cases are even measured, such as horizontal polarization below 30 MHz.

John Matz KB9II
24 Feb 2004

BPL Comments - Part 2
25 February 2004
John Matz KB9II

... More BPL Comments

* IF Resolution Bandwidth *

Someone might ask why I am so insisten about specifying a measurement bandwidth for the corresponding emission level. Well, in most cases, where the spurious emission is a single unmodulated carrier, the measuremenr bandwidth doesn't matter. An unmodulated carrier has all its power at one frequency and reads the same power with a 1 kHz or 1 MHz IF bandwidth receiver. The problem is when the carrier is modulated, especially with high speed data. Say we have a 1 milliwatt carrier with BPSK modulation of a 100 KBPS data stream. The signal is at least 100 kHz wide now at an almost constant level. If the test receiver has a 1 MHz IF bandwidth, practically all the signal is contained in the IF bandwidth and the power read by the receiver is 1 milliwatt. But say the receiver IF resolution bandwidth (before detection) is reduced to 10 kHz. The receiver now only sees 10 kHz at a time. It reads power at less than a tenth of a milliwatt now, 0.1 mw. If it is set to 1 kHz, it will only see a hundredth of the power in the modulated signal, 0.01 mw. This makes the indicated power level drop by 20 dB or more. Obviously the reading, and compliance to an emissions limit, depend on the resolution bandwidth used on a modulated carrier in a system carrying data traffic.

* CISPR and Test Receivers *

It is not clear what bandwidth is to be used for Part 15 measurements. Part 15 allows the use of compliance by showing that the unit meets CISPR limits, usually CISPR 16-1. CISPR is a Europen stangard that is more restrictive than Part 15. It provides limits that decrease with increasing frequency, which makes a lot of sense. CISPR receivers usually make measurements in a 10 kHz resolution bandwidth too, at least through 30 MHz test frequency. A 10 kHz measurement bandwidth gives a 20 dB lower reading than a 1 MHz bandwidth on high apeed data modulation.

* Poor Measurements *

As one can see, Part 15 does little to control interference. The limit is set at a high number. It is not changed with frequency. No measurement bandwidth is specified. NPRM Appendix C only measures vertically polarized emissions, not horizontally polarized ones. So if one wants to show Part 15 compliance and make emissions look 30 dB better, one simply has to be cross-polarized and turn the test instrument bandwidth down to 1 kHz. Then you can be in compliance. The difficulty is that you have not really changed the emissions. The unit under test could exceed CISPR in a 10 kHz bandwidth by 40 dB and it could still pass Part 15.

What's sad is that CISPR limits are not even tight enough to control interference. There have been even tighter limits in some proposals in Europe, but CISPR limits are out there now. Too bad. Part 15 is even looser.

* More Recommendations *

Part 15 was created to control interference to and from broadcast receivers. Spurious signals were almost always unmodulated. In this new era of unlicensed transmitters, Part 15 limits are not adequate. It seems that Part 15 should be changed for future products to a minimum of CISPR-style limits with measurement bandwidth specified. Unlicensed transmitters should have specific radiation limits and should be placed in specific bands for unlicensed operation. That way, they will not interfere with licensed higher power stations on other frequencies.

John Matz KB9II
25 Feb 2004